Honey Bee of Serbia

A Population-Genetic Perspective

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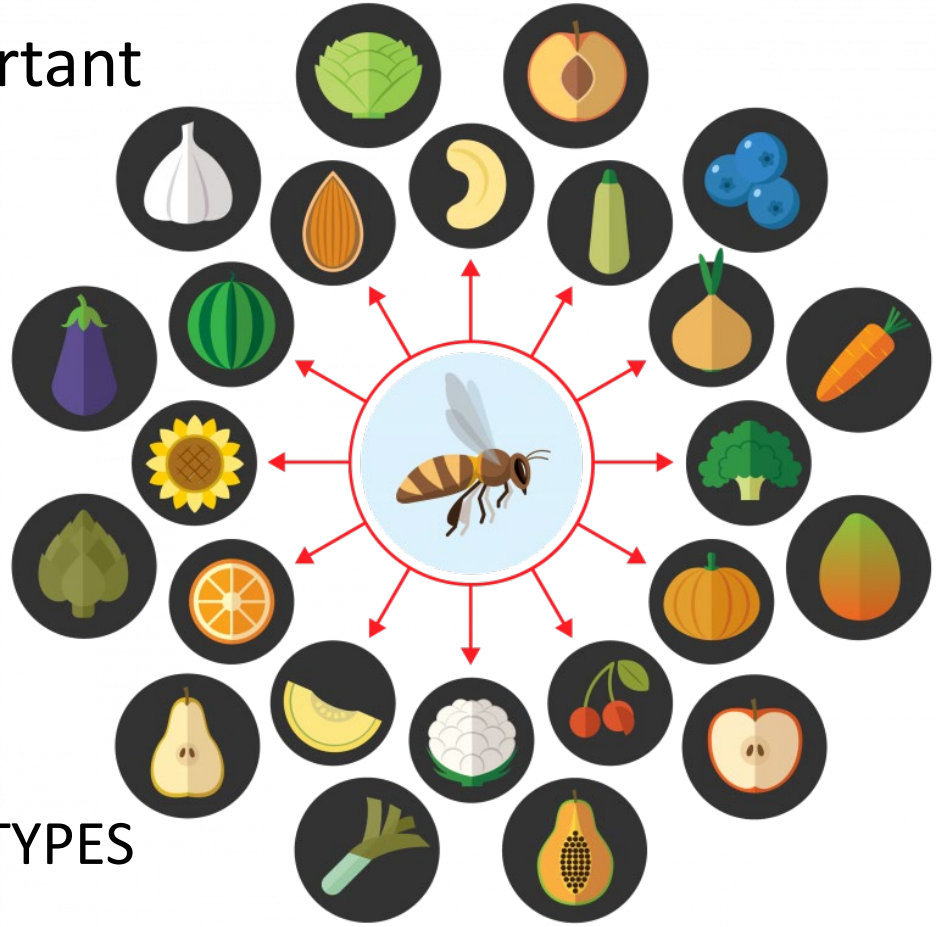
Apis mellifera - EUROPEAN HONEY BEE

- Economically and ecologically the most important **key crop pollinator**

- Native to Africa, Asia, and Europe
- Present day – Cosmopolitan

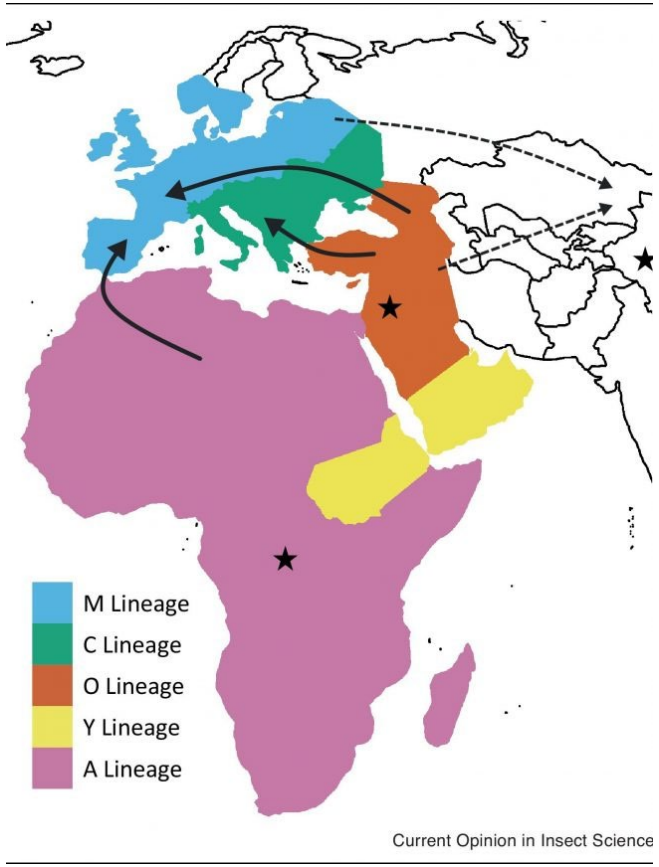
- ≈30 described subspecies

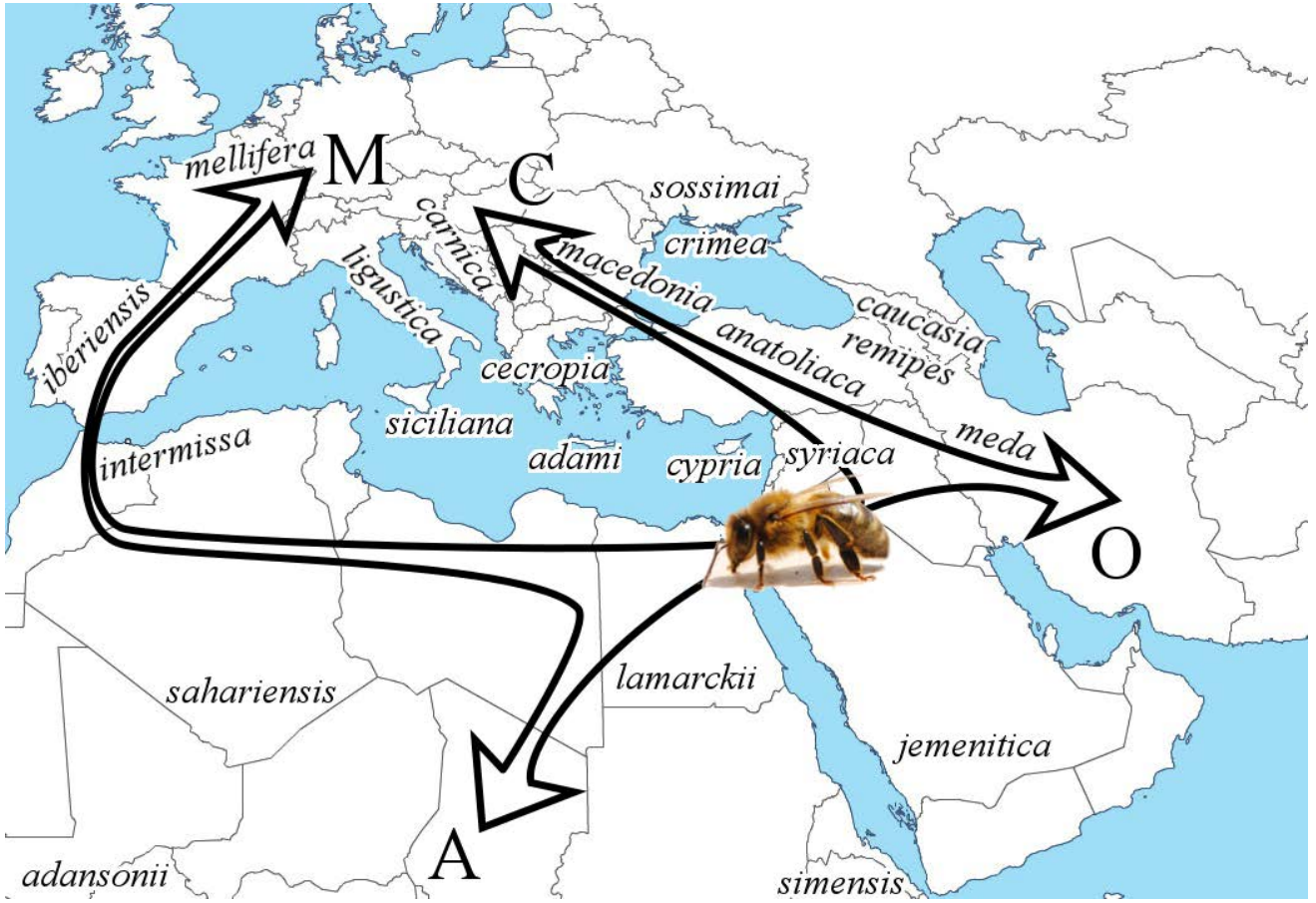
- Within the subspecies, there are various ECOTYPES



Apis mellifera

- Five evolutionary lines





K.A. Dogantzis, A. Zayed (2019)
Recent advances in population and quantitative genomics of honey bees
Curr. Opin. Insect Sci., 31 pp. 93-98

Gil Leclercq, Nicolas Gengler & Frédéric Francis (2018)
How human reshaped diversity in honey bees (*Apis mellifera* L.): a review
Entomologie Faunistique – Faunistic Entomology 71

Honey Bee of Serbia

Central part of the distribution area of the **C Line**

Literature data

2 SUBSPECIES in Serbia:

Apis mellifera carnica – North-West

Apis mellifera macedonica – South-East

3 ECOTYPES characteristic for specific geographic regions:

Banatski, Sjenica-Pešterski and Timočki

mtDNA analysis – more than 7 Haplotypes

Microsatellite analysis – clinal distribution North-South and East-West

Material for last genetic analysis was collected between 2005-2012

2005-2007 Stevanovic, Nedić 2009-2010, Munoz 2007-2012

Honey Bee of Serbia

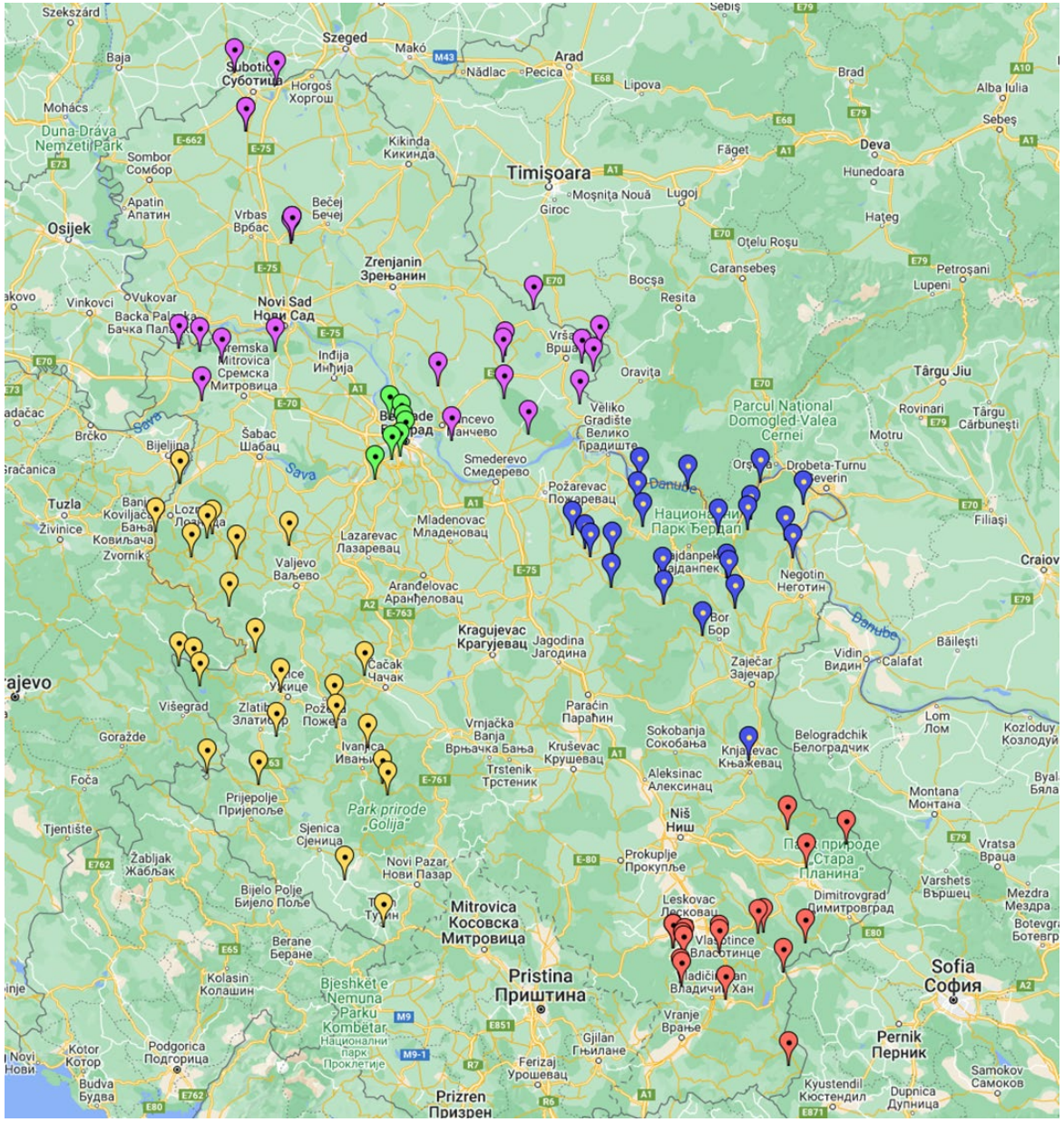
Managed honey bees – **APIARIES**

Terms:

- The older apiaries
- Stationary apiaries
- Without introduction of Queens for a long period of time

GOALS:

- Describing the genetic variability of honey bees of our country
- Establish a picture of population structure of Serbian honey bees
- Recognition of locally adapted ecotypes and populations



Honey Bee of Serbia

Managed honey bees – **102** **APIARIES**

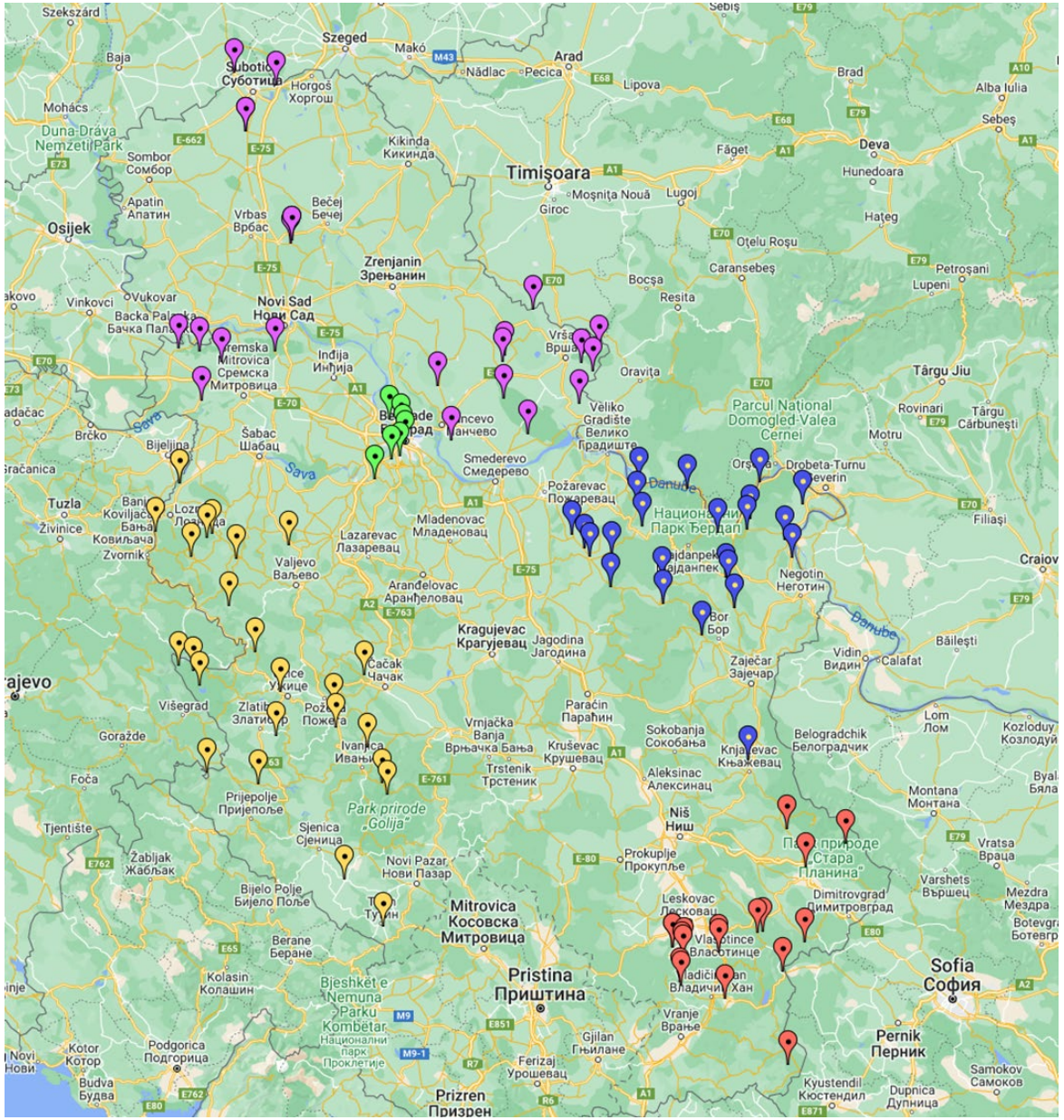
NORTH (Vojvodina): Palić, Fruška Gora, Deliblatska peščara, Vršac

SOUTH: Leskovac, Stara planina, Vlasina, Grdelička gorge

WEST: Ovčarsko-kablarska gorge, Valjevo, Tara, Uvac, Sjeničko-pešterska visoravan

EAST: Đerdapska gorge, Homolj, Kučaj, Negotin

BELGRADE



SERBHIWE project

Two goals in research

MANAGED HONEY BEES

- apiaries

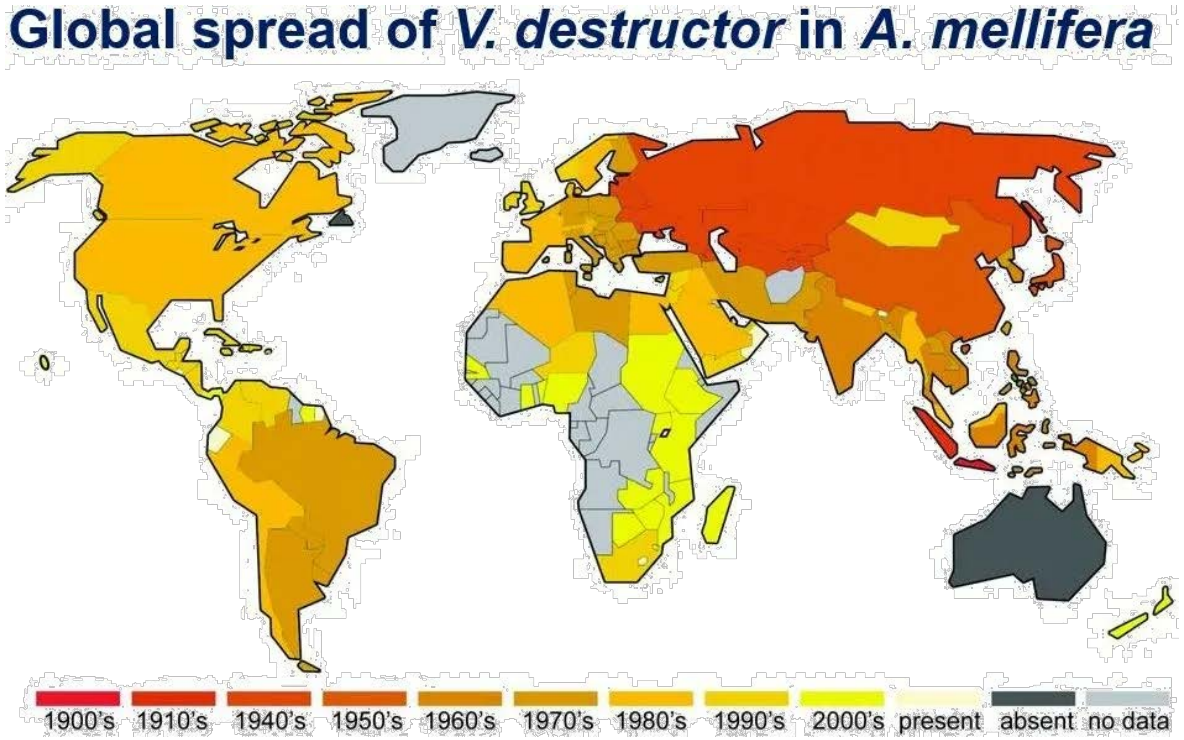
FREE-LIVING HONEY BEES

– natural habitats and urban environments

Free-living honey bee colonies

- the disappearance of wild honey bees in the natural habitats of Europe

Varroa destructor



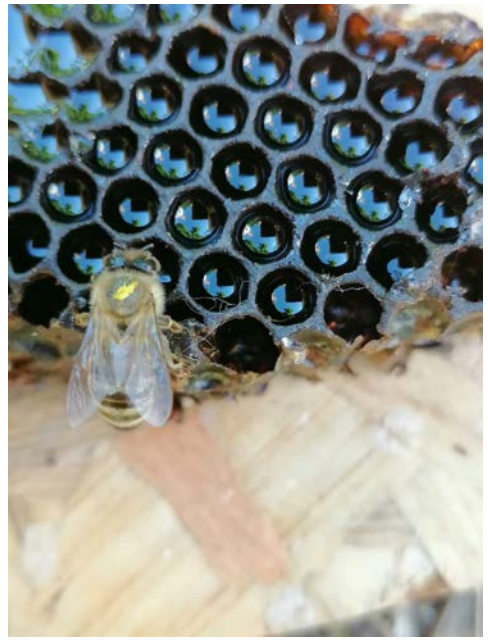
Free-living honey bee colonies

- Wild
  or
- Feral

Free-living honey bee colonies
sampling methods

1. *Beelining* method - "following the line of bee flight“

Catching, marking, releasing and *waiting*, moving in the direction of the bees' flight



Free-living honey bee colonies

sampling methods

2. Searching for information

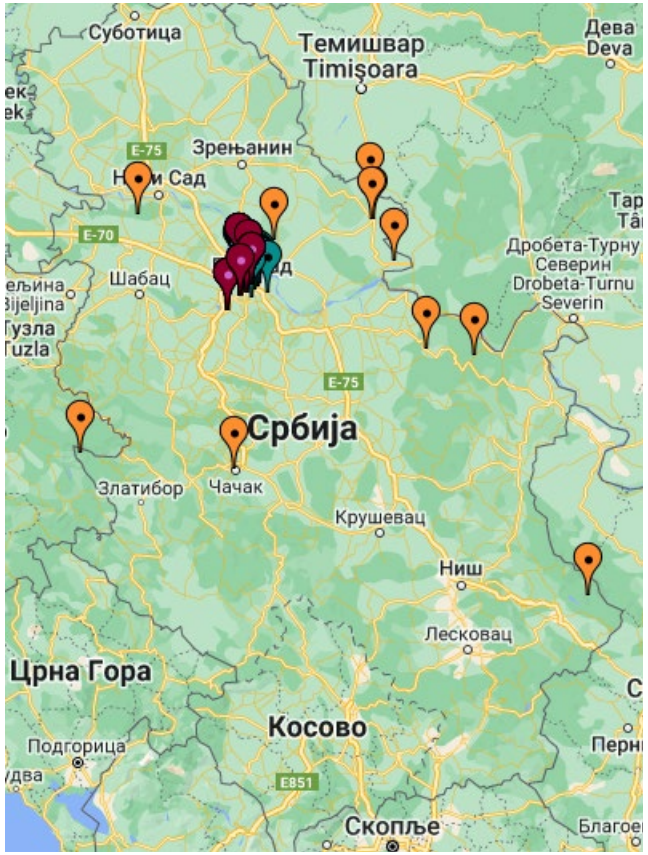
Free-living honey bee colonies

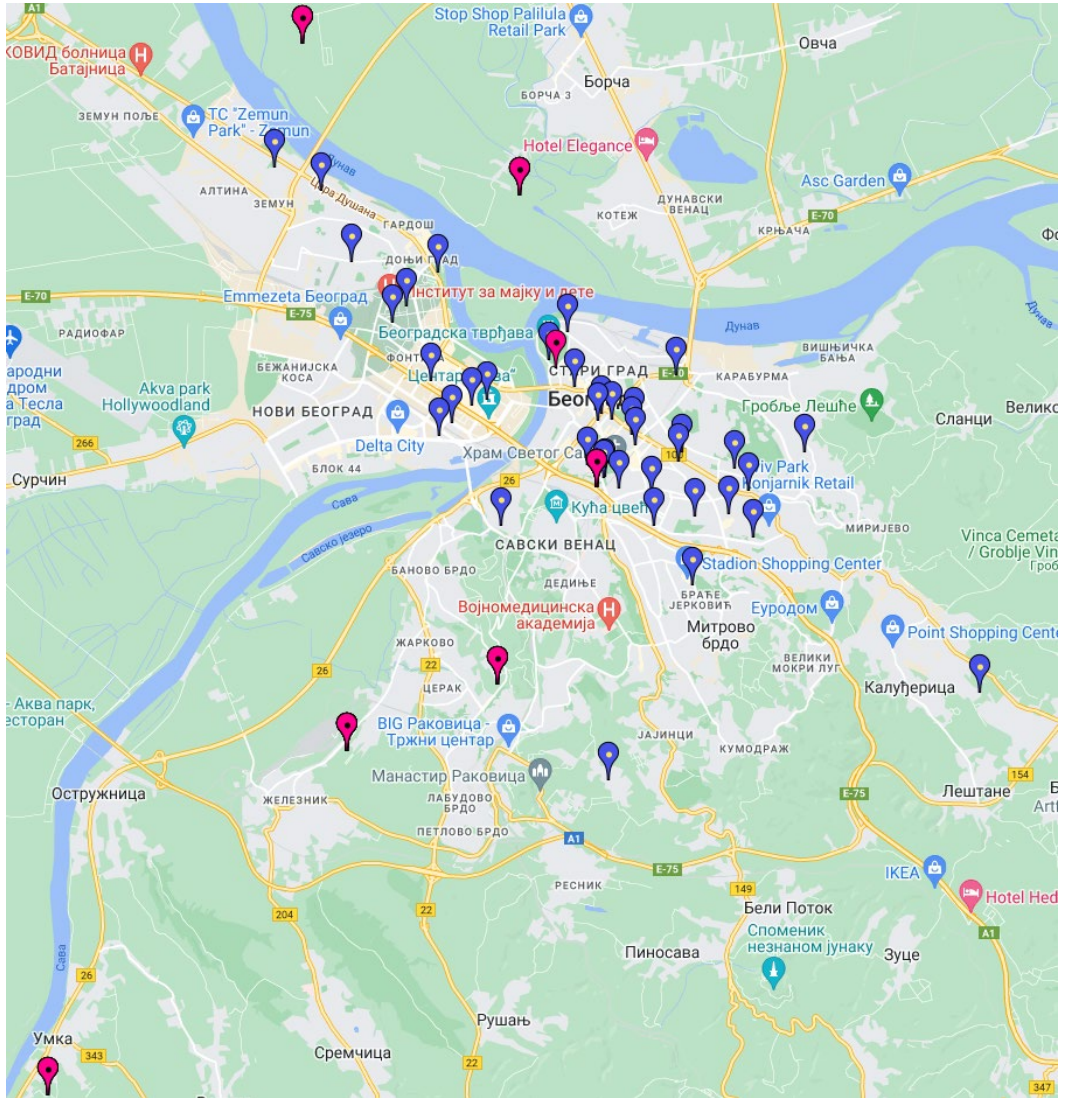
Problemi na terenu

Free-living honey bee colonies

natural habitats

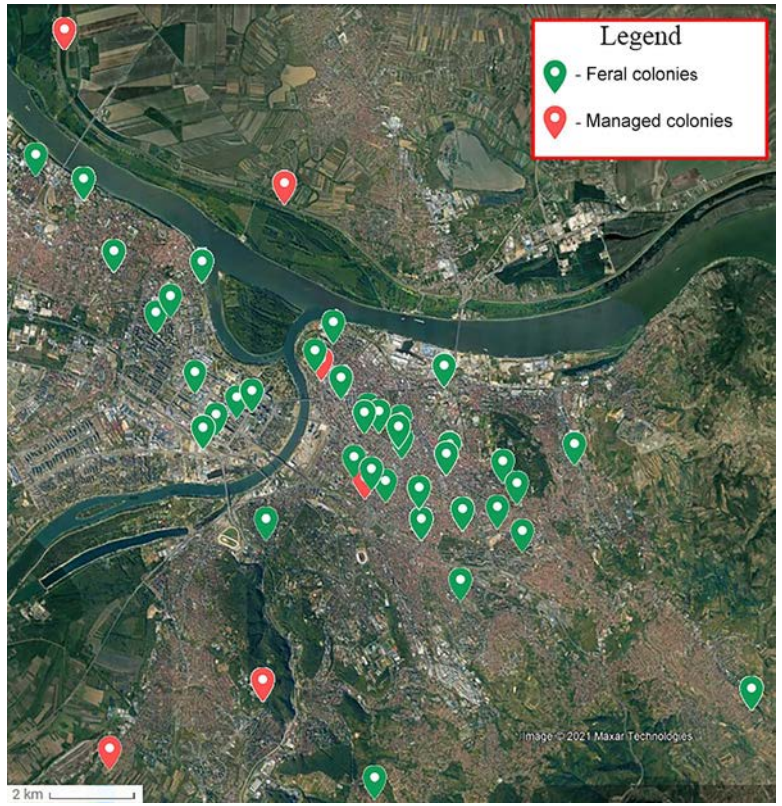
and urban environments (56)





Free-living honey bee colonies

database of feral societies on the territory of Belgrade



Honey Bee of Serbia

Over 930 honey bee colonies (HIVES)
542 workers have been selected FOR GENETIC ANALYSES
+ 56 free-living workers

2 types of GENETIC MARKERS:

1. **Mitochondrial DNA (**mtDNA**)**
   $tRNA^{leu}$-cox2 intergenic region
   COI

2. **Microsatellites** - 14 Loci
   A7, A8, A14, A24, A28, A35, A43, A79, A88, A107, A113, Ap43, **Ap249, B124**

mtDNA: RFLP analysis on the COI gene segment

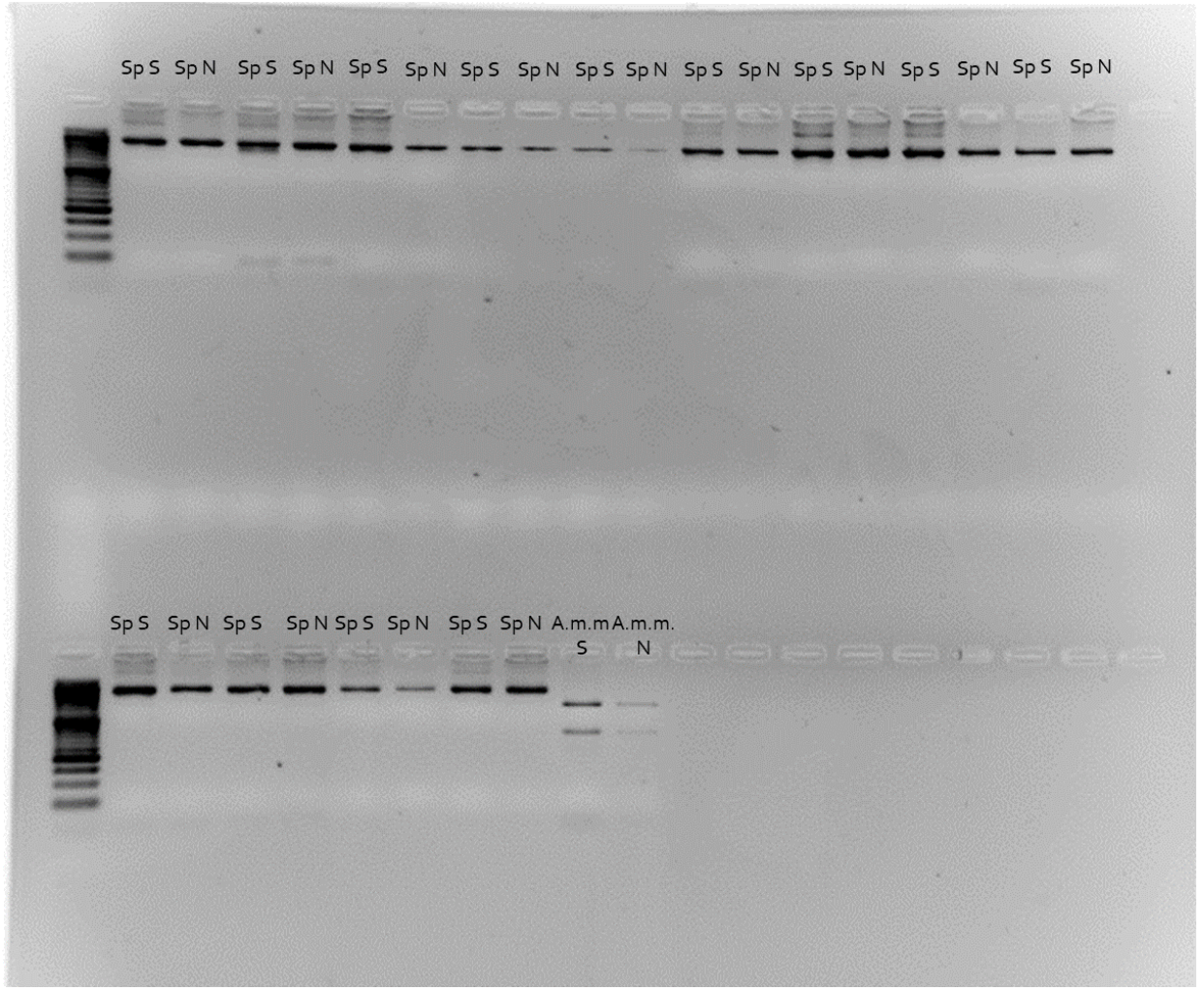
to distinguish two subspecies

A. m. carnica from *A. m. macedonica*

COI Segment: 1029 bp

2 Restriction Enzymes: *NcoI* and *StyI*

- RFLP analysis showed the **presence of *A. m. carnica*** subspecies only
- Absence of *A. m. macedonica* subspecies from its historic range of distribution in southern Serbia



mtDNA: *tRNA^{leu}-cox2* intergenic region

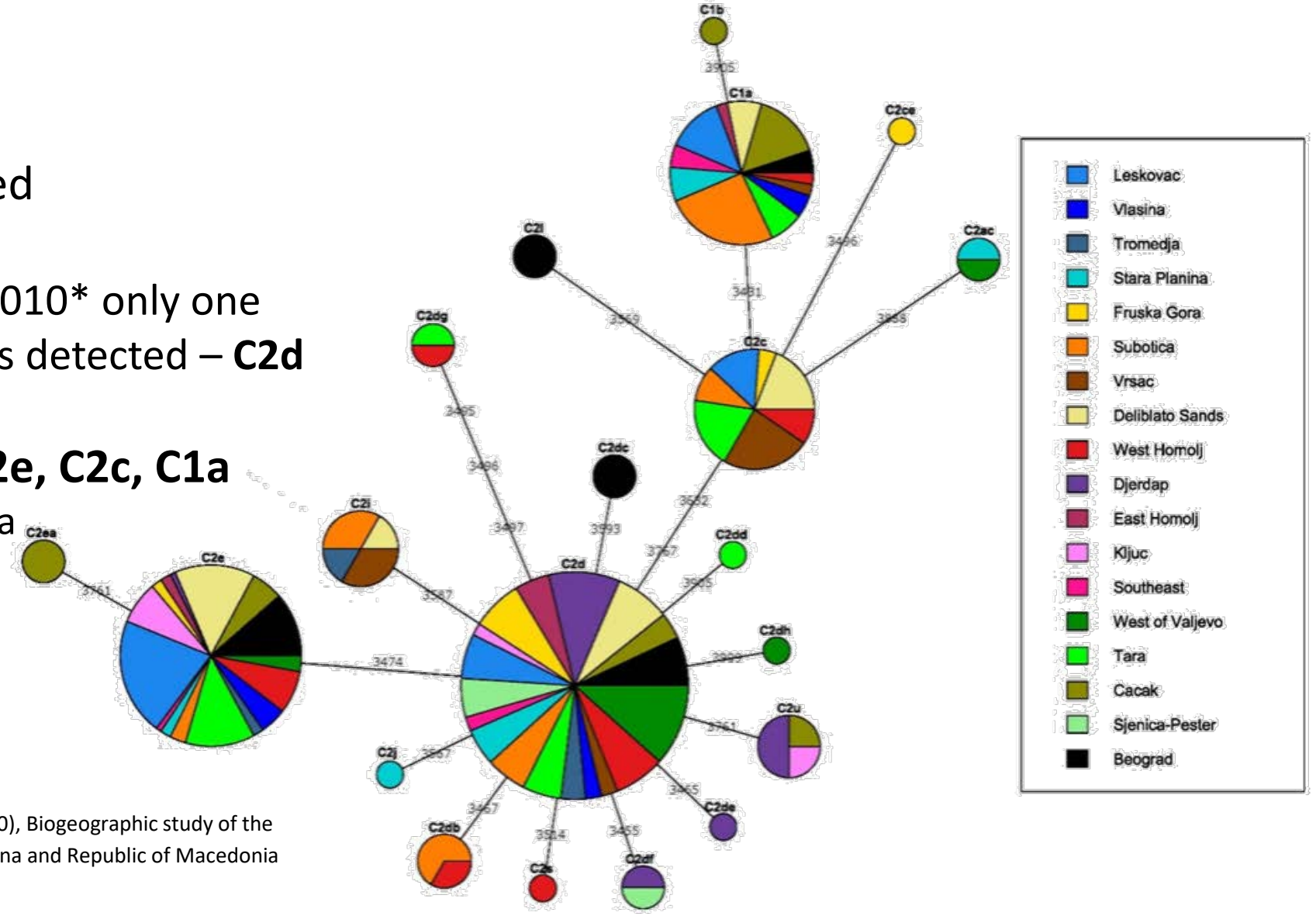
- 20 haplotypes
- 10 - the first time described

- In a study Stevanović et al. 2010* only one mitochondrial haplotype was detected – **C2d**

- the most frequent **C2d, C2e, C2c, C1a**

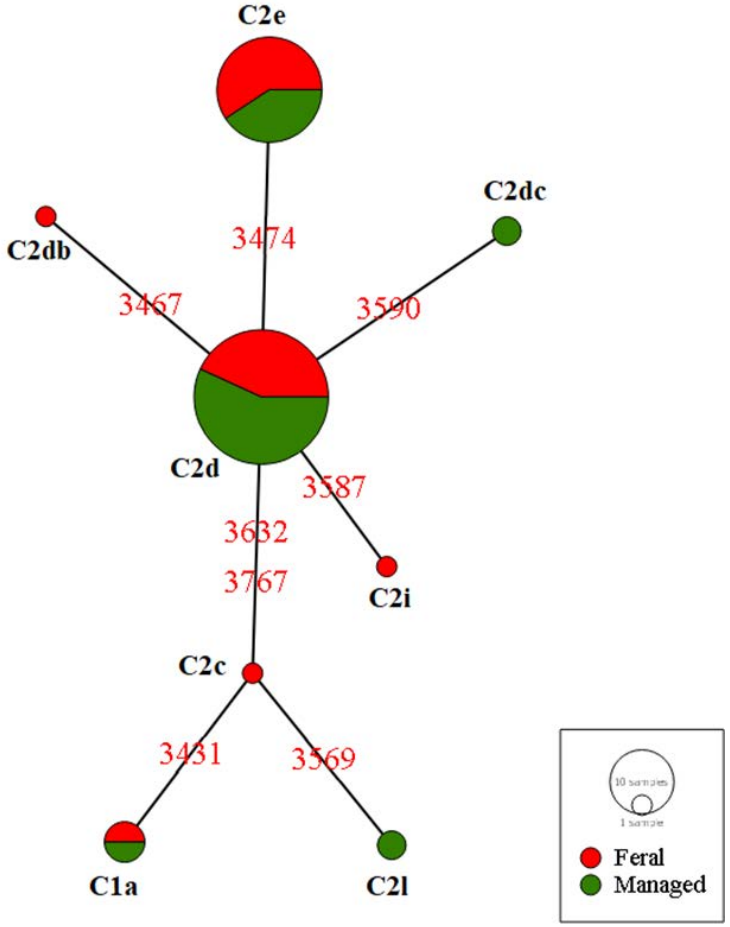
represented in all regions of Serbia

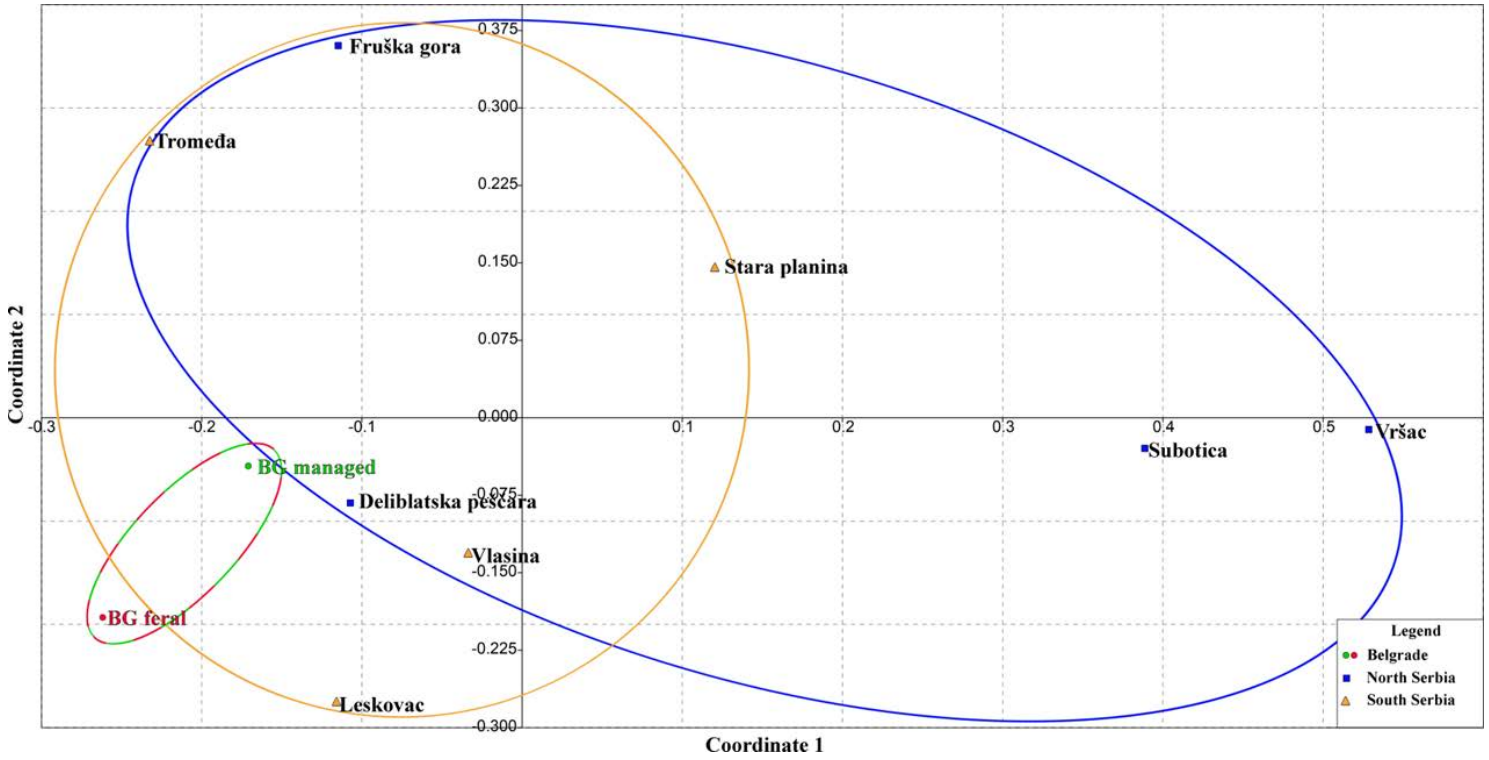
- **high gene flow**



* Stevanovic J, Stanimirovic Z, Radakovic M, Kovacevic SR (2010), Biogeographic study of the honey bee (*Apis mellifera* L.) from Serbia, Bosnia and Herzegovina and Republic of Macedonia based on mitochondrial DNA analyses, Genetika 46(5), 685-91

mtDNA – BG feral and managed honey bee

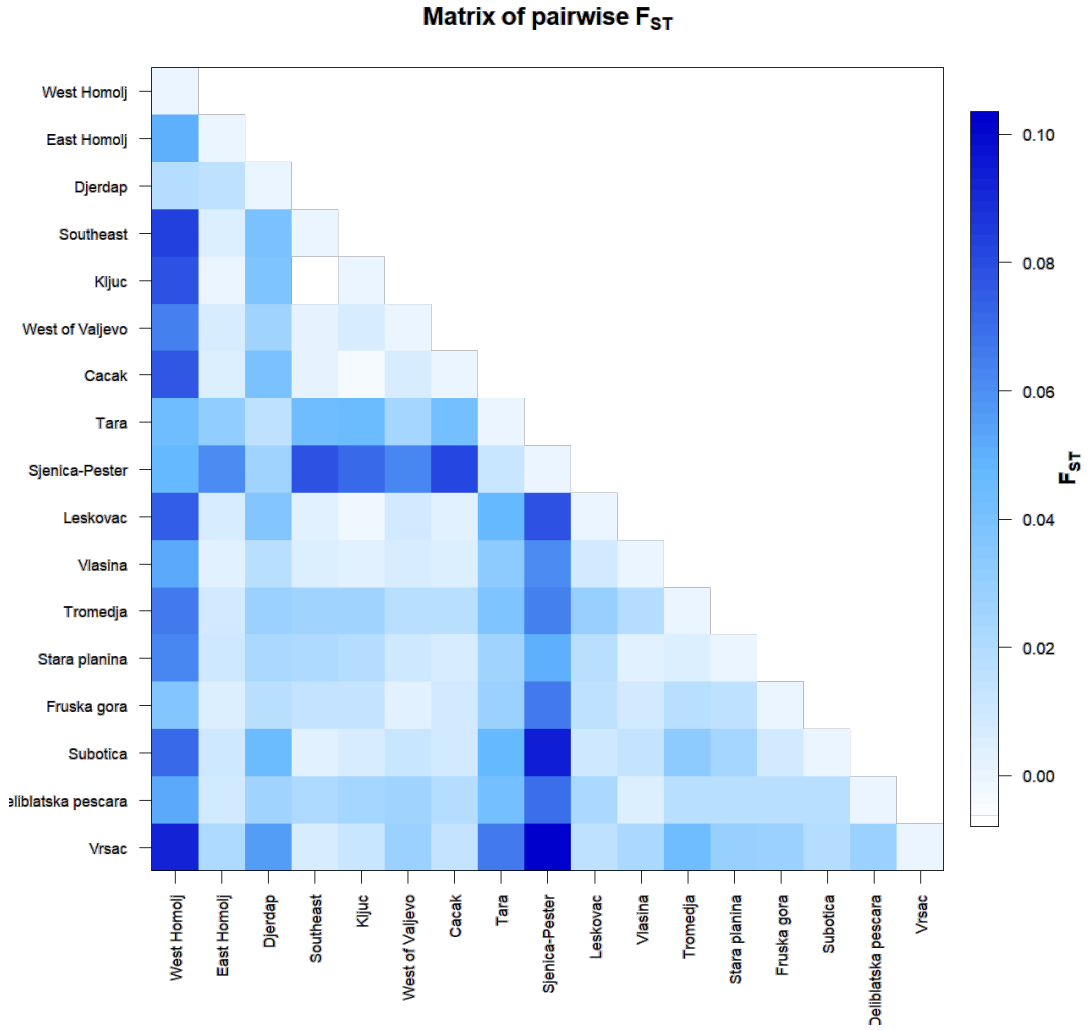




Microsatellites – managed honey bees

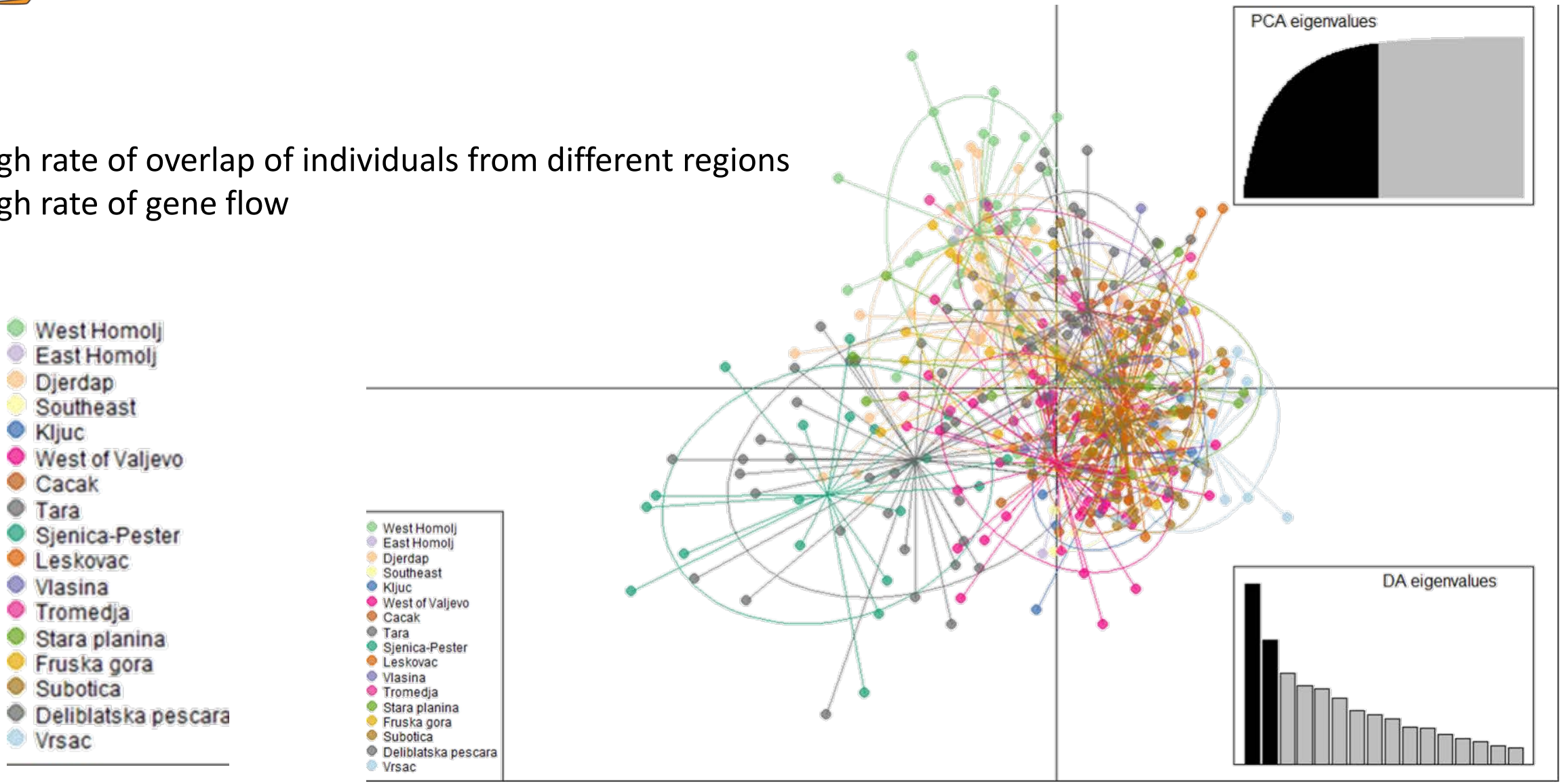
PARAMETERS OF GENETIC DIVERSITY

- Uniform
- Expected heterozygosity higher than observed
- The highest average diversity of genes by loci: Sjenica-Pešter region

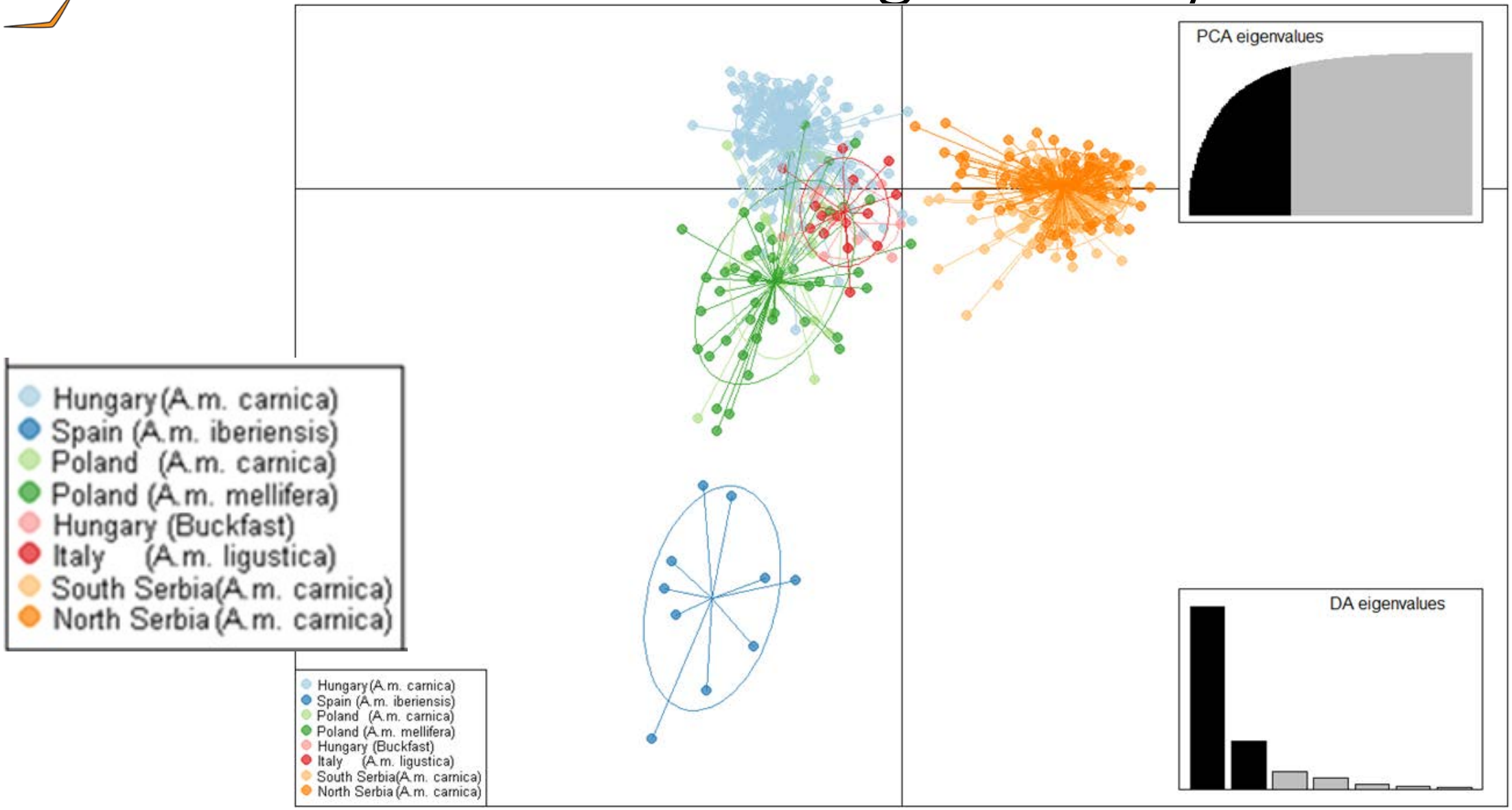


Microsatellites – managed honey bees

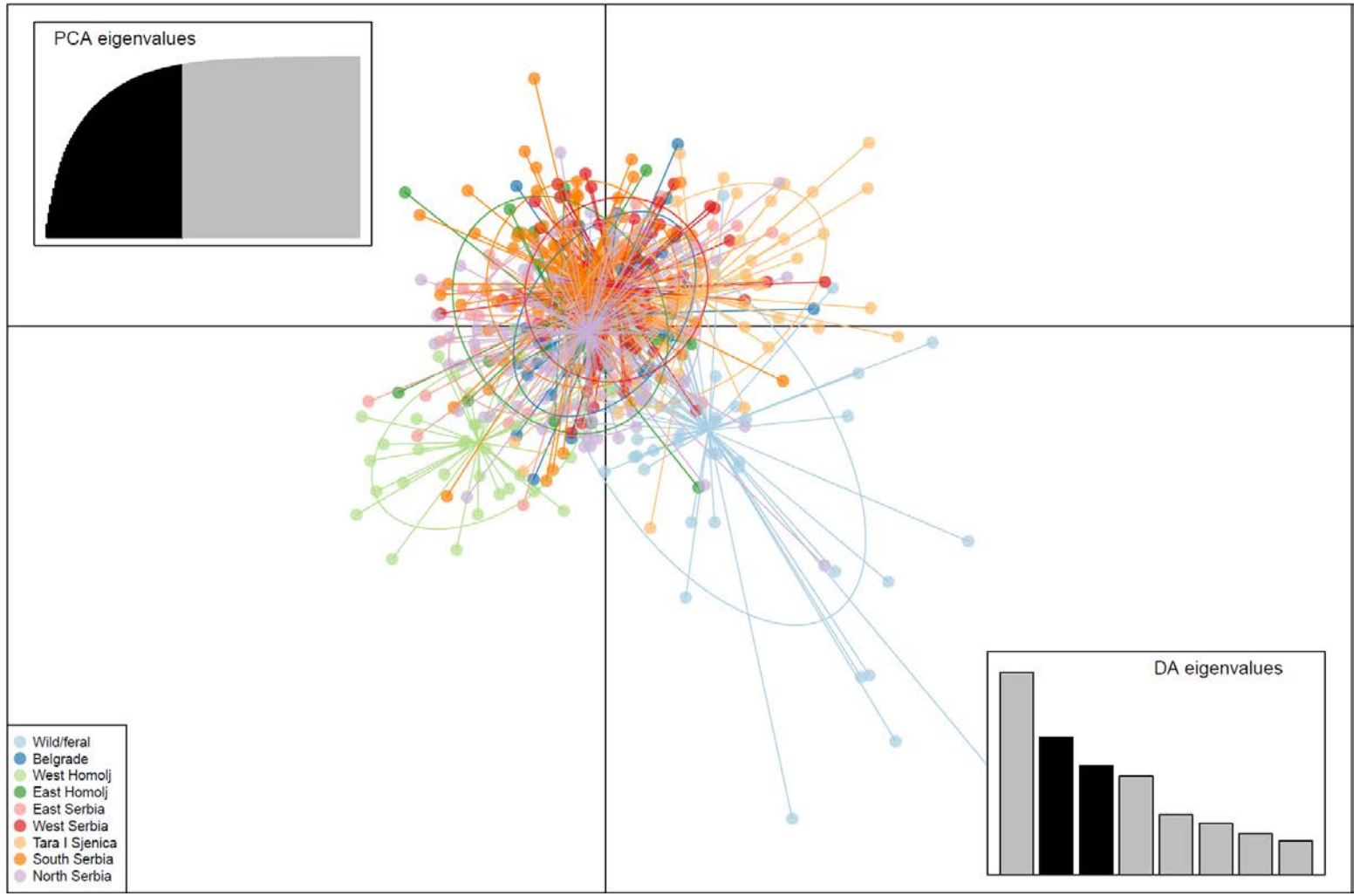
High rate of overlap of individuals from different regions
High rate of gene flow



Microsatellites – managed honey bees



Microsatellites - managed *vs*. feral

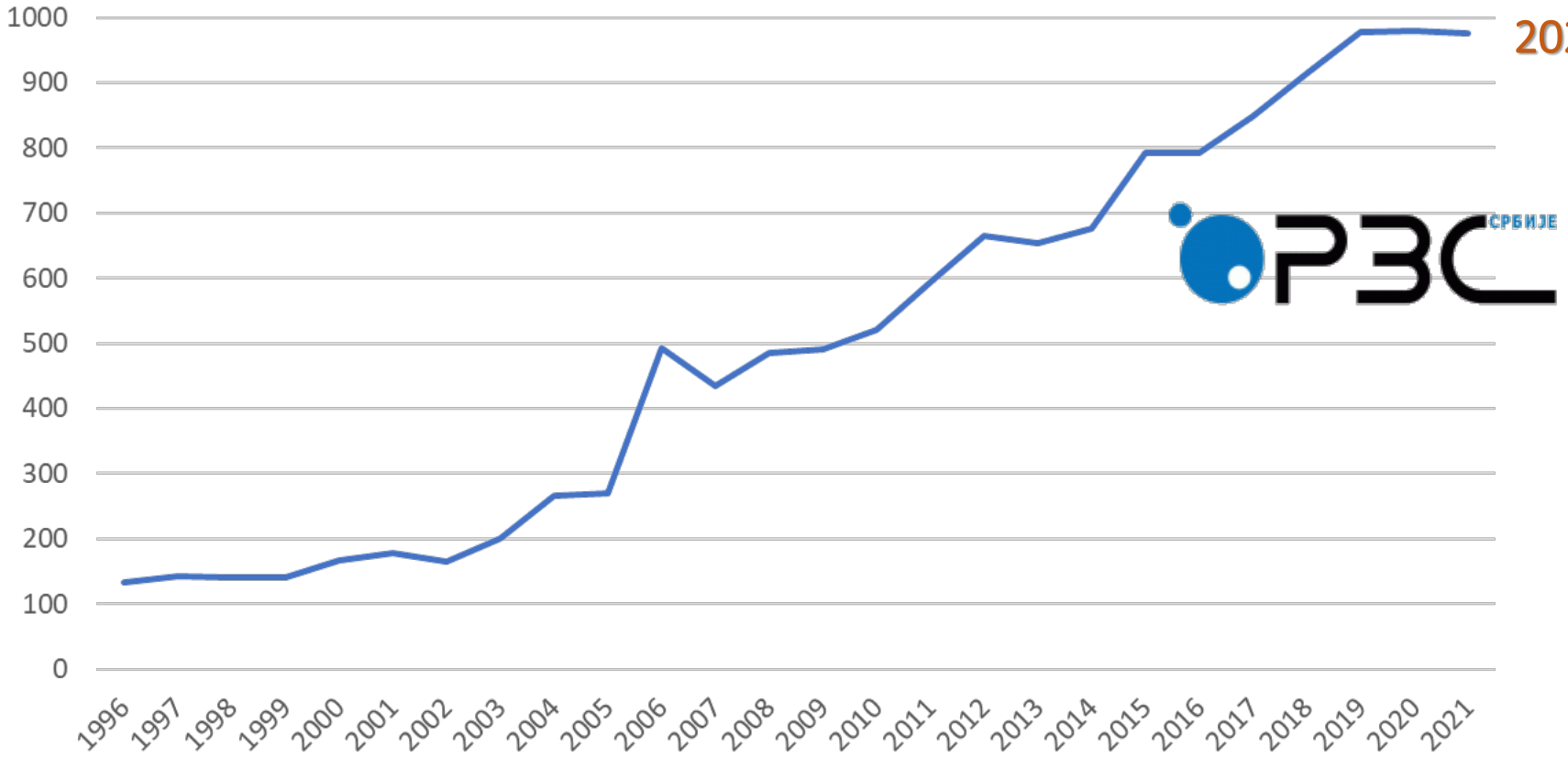


https://radar.ibiss.bg.ac.rs/bitstream/handle/123456789/4954/Figure%20S5.html?sequence=1&isAllowed=y

Microsatellites - Serbian honey bees

Some possible explanations

number of hives in thousands



2021. – 976.000 hives

РЗС СРБИЈЕ

Statistical Office of the Republic of Serbia

https://data.stat.gov.rs/Home/Result/130202010207?languageCode=sr-Cyrl

Some possible explanations

Change in beekeeping practices – the traditional beekeeping way has been lost

Modern Beekeeping:

- Queen importation
- Large-scale and long-distance migratory beekeeping
- Commercial honey bee breeding and selection for desired traits

Some possible explanations

Law on Animal Husbandry of the Republic of Serbia

(Official Gazette of RS, No. 41/2009, 93/2012 and 14/2016, Article 70)

allows the cultivation of Carniolan honey bee

Especially preservation of biodiversity bee races *Apis mellifera carnica*

Article 70.

In order to preserve biodiversity bees Apis mellifera carnica in the territory of Republic of Serbia is not allowed breeding and trade with breeding material from other races of bees.

Free-living honey bee colonies

GREATER GENETIC VARIABILITY

- Reservoir of genetic diversity
- Subject to natural selection
- Better adapt to diseases, pathogens, and adverse, challenging habitat conditions.

Honey Bee of Serbia – Population-Genetic Perspective

RESULTS

- *MtDNA lineages characteristic for **A.m.macedonica subspecies** could **not be detected***
- *MtDNA genetic diversity has substantially changed and in **free-living colonies it exhibits a bit higher values of genetic diversity***
- ***Genetic differentiation** among different regions is **non-existent or weak***
- ***Sjeničko-pešterski ecotype** could most likely be differentiated*
- ***Free-living honey bees colonies of Belgrade** represent a **stable self sustainable population** (with small or non detectable input of swarms from managed apiaries)*

- *Current situation calls for a change in honey bee management*

insects

MDPI

Article

Unprecedented Density and Persistence of Feral Honey Bees in Urban Environments of a Large SE-European City (Belgrade, Serbia) †

Jovana Bila Dubaić [1], Slađan Simonović [2], Milan Plećaš [1], Ljubiša Stanisavljević [1,*], Slobodan Davidović [3], Marija Tanasković [3] and Aleksandar Ćetković [1]

insects

MDPI

Article

MtDNA Analysis Indicates Human-Induced Temporal Changes of Serbian Honey Bees Diversity

Marija Tanasković [1,*], Pavle Erić [1], Aleksandra Patenković [1], Katarina Erić [1], Milica Mihajlović [2], Vanja Tanasić [2], Ljubiša Stanisavljević [3] and Slobodan Davidović [1]

proceedings

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Proceedings

Microsatellite Analysis of *Apis mellifera* from Northern and Southern Parts of Serbia †

Marija Tanasković [1*], Aleksandra Patenković [1], Katarina Erić [1], Pavle Erić [1], Ljubiša Stanisavljević [2] and Slobodan Davidović [1]

insects

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Article

Further Evidence of Population Admixture in the Serbian Honey Bee Population

Marija Tanasković [1,*], Pavle Erić [1], Aleksandra Patenković [1], Katarina Erić [1], Milica Mihajlović [2], Vanja Tanasić [2], Szilvia Kusza [3], Andrzej Oleksa [4], Ljubiša Stanisavljević [5] and Slobodan Davidović [1]

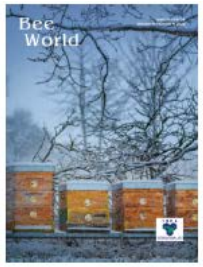
OPEN

scientific reports

Urban ecosystem drives genetic diversity in feral honey bee

Aleksandra Patenković[1], Marija Tanasković[1], Pavle Erić[1], Katarina Erić[1], Milica Mihajlović[2], Ljubiša Stanisavljević[3] & Slobodan Davidović[1]

Александра Патенковић
НАУЧНИ ПРОЈЕКАТ SERBHIWE 365

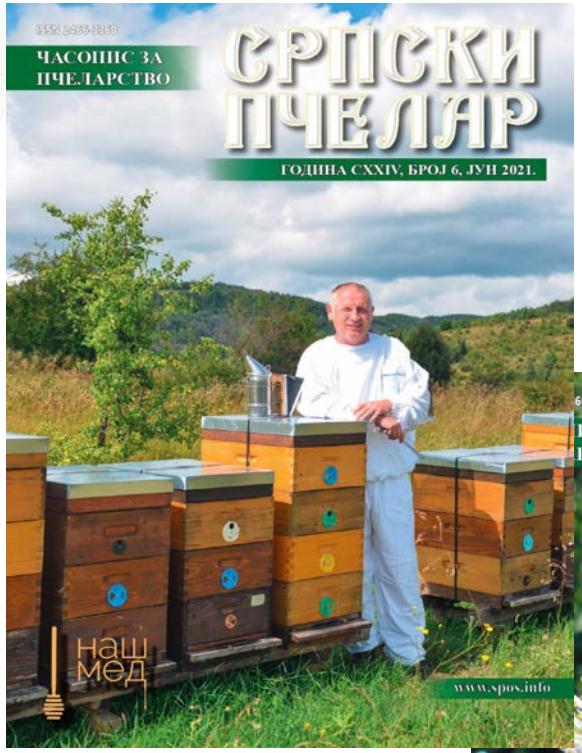


Bee World

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tbee20

Insight into Free-Living Honey Bee Population in Serbia's Capital – A COLOSSal Walk around Belgrade

Jovana Bila Dubaic´, Raffaele Dall'Olio & Slobodan Davidovic´



STRUČNI RAD

Genetička raznovrsnost i budućnost medonosne pčele u Srbiji

Autori: Aleksandra Patenković[1], Pavle Erić[1], Katarina Erić[1], Marija Tanasković[1], Ljubiša Stanisavljević[2], Slobodan Davidović[1]

Слободан Давидовић
ПРОЈЕКАТ SERBHIWE: РЕЗУЛТАТИ И ПОУКЕ 427

Notable Articles

Insect Societies and Sociality
Bayesian Multi-Targets Strategy to Track *Apis mellifera* Movements at Colony Level
Jordão N. Oliveira, Jr. et al.

Insect Societies and Sociality
Geographical Variation of Honey Bee (*Apis mellifera* L. 1758) Populations in South-Eastern Morocco: A Geometric Morphometric Analysis
Abdessamad Aglagane et al.

Insect Societies and Sociality
Translocation of Tebuconazole between Bee Matrices and Its Potential Threat on Honey Bee (*Apis mellifera* Linnaeus) Queens
Risto Raimets et al.

Insect Physiology, Reproduction and Development
Functional Properties and Antimicrobial Activity from Lactic Acid Bacteria as Resources to Improve the Health and Welfare of Honey Bees
Massimo Iorizzo et al.

Advanced in Honey Bee and Apitherapy
Low-Level Fluvalinate Treatment in the Larval Stage Induces Impaired Olfactory Associative Behavior of Honey Bee Workers in the Field
Chong-Yu Ko et al.

Insect Societies and Sociality
Sex-Specific Regulatory Systems for Dopamine Production in the Honey Bee
Ken Sasaki et al.

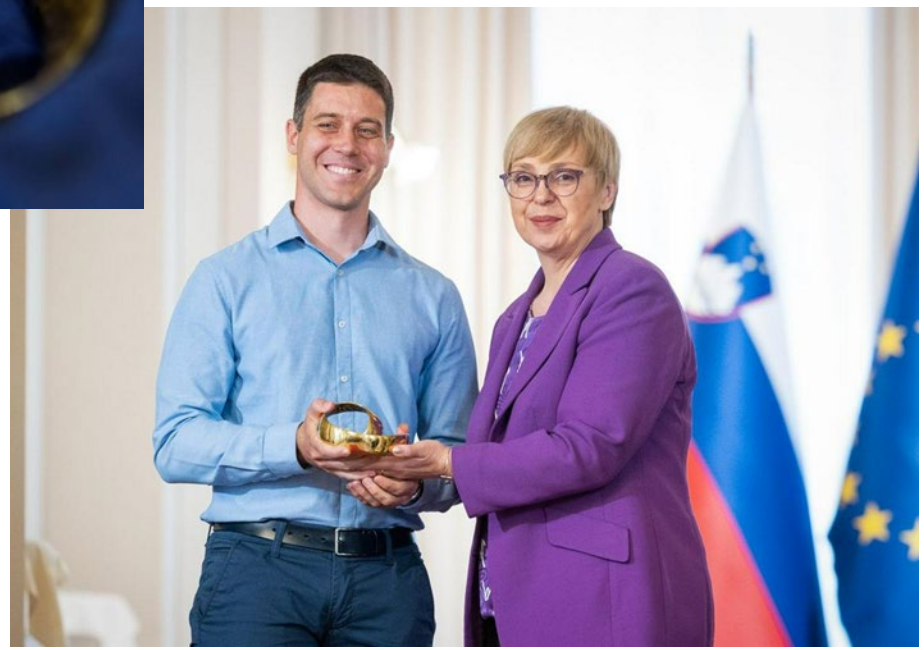
Insect Societies and Sociality
Differential Expression of Major Royal Jelly Proteins in the Hypopharyngeal Glands of the Honeybee *Apis mellifera* upon Bacterial Ingestion
Yun-Hui Kim et al.

Insect Societies and Sociality
^{1}H NMR Profiling of Honey Bee Bodies Revealed Metabolic Differences between Summer and Winter Bees
Saetbyeol Lee et al.

Insect Societies and Sociality
Effects of Thiamethoxam-Dressed Oilseed Rape Seeds and Nosema ceranae on Colonies of *Apis mellifera iberiensis*, L. under Field Conditions of Central Spain. Is Hormesis Playing a Role?
Elena Alonso-Prados et al.

Selected Papers from the 1st International Electronic Conference on Entomology
Further Evidence of Population Admixture in the Serbian Honey Bee Population
Marija Tanasković et al.

International **Golden Bee Award** Slovenia, 2023.



SERBHIWE project

July 2020. – September 2022.

TEAM members:

- dr Slobodan Davidović (PI)
- dr Marija Tanasković
- dr Aleksandra Patenković
- Katarina Erić
- Pavle Erić

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Department of Invertebrate Zoology and Entomology Faculty of Biology, University of Belgrade


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BORN TO BEE
WILD